CLAIM AMENDMENTS

1. (Currently Amended) A circuit board (5) consisting of at least two individual circuit board layers (10) made of plastics and produced by formation technique, which each have first and second functional sides and at least one microstructured positioning formation (16), said at least one microstructured positioning formation being comprised of at least one projection and at least one recess positioned in interconnecting engagement, said at least one projection being formed on at least one of the first and second functional sides of one of said at least two individual circuit board layers (10), said at least one recess being formed on at least one of the first and second functional sides of another of said at least two individual circuit board layers (10) and positioned in interconnecting engagement with said at least one projection, each of said at least one projection and said at least one recess ~~said positioning formation~~ being formed integrally and simultaneously with one of said at least one individual circuit board layers during formation of said circuit board layers and being formed of material which is the same as the circuit board layer, and at least one microstructured conductor trench (12) on one of the functional sides, the conductor trench (12) being provided with a metallization (18).

2. (Original) The circuit board according to claim 1, characterized in that the positioning formation (16) is a protrusion.

3. (Original) The circuit board according to claim 2, characterized in that the protrusion (16) is in the shape of a pyramid.

4. (Original) The circuit board according to claim 1, characterized in that the positioning formation (16) is a depression.

5. (Original) The circuit board according to claim 4, characterized in that the depression

(16) is complementary to a pyramid-shaped protrusion.

6. (Previously Amended) The circuit board according to claim 2, characterized in that each individual layer is provided on one functional side with a plurality of protrusions (16) and on the other functional side with a plurality of depressions (16), the protrusions of the one individual layer engaging into the depressions of the other individual layer, so that the two individual layers are precisely positioned in relation to each other.

7. (Withdrawn) The circuit board according to claim 1, characterized in that the positioning formation is an opening (16) which extends from the one functional side through the individual layer (10) and as far as to the other functional side.

8. (Withdrawn) The circuit board according to claim 7, characterized in that a positioning pin (38) is provided which extends through the openings (16) in the individual layers, so that the two individual layer are precisely positioned in relation to each other.

9. (Withdrawn) The circuit board according to claim 1, characterized in that the conductor trench (12) extends as far as to the edge of the circuit board, so that a plug connector may be connected.

10. (Withdrawn) The circuit board according to claim 9, characterized in that the conductor trench (12) is semicircular in cross section.

11. (Previously Amended) The circuit board according to claim 1, characterized in that the conductor trench (12) is rectangular in cross-section.

12. (Withdrawn) The circuit board according to claim 9, characterized in that a first conductor trench (12) is provided on one of the individual layers (10) and a second conductor trench (12) is provided on the other individual layer (10) and that the two conductor trenches are

located centered opposite each other, one of the conductor trenches having smaller dimensions that the other conductor trench.

13. (Withdrawn) The circuit board according to claim 12, characterized in that the two conductor trenches (12) extend as far as to the edge of the circuit board (5) and a plug-in connection for an RF line is provided.

14. (Withdrawn) The circuit board according to claim 13, characterized in that the space between the conductor trenches (12) located opposite each other is filled with air.

15. (Previously Amended) The circuit board according to claim 1, characterized in that a cooling groove (20) is provided on at least one of the individual layers, the cooling groove being filled with a metallization (18) of a thickness such that a heat sink is formed.

16. (Withdrawn) The circuit board according to claim 1, characterized in that a cooling channel (34) is provided on at least one of the individual layers, the cooling channel being adapted for a cooling agent (36) to be conducted therethrough, and that the other individual layer covers the cooling channel.

17. (Withdrawn) The circuit board according to claim 16, characterized in that the cooling channel extends as far as to the edge of the circuit board (5) and a connection for the cooling agent is formed.

18. (Withdrawn) The circuit board according to claim 1, characterized in that at least one mount (26) for an electronic, optical or optoelectronic component (28) is provided in at least one of the individual layers.

19. (Withdrawn) The circuit board according to claim 18, characterized in that a recess (32) located opposite the mount is provided in the other individual layer.

20. (Previously Amended) The circuit board according to claim 1, characterized in that the two individual layers are connected with each other by an electrically conductive material (24).

21. (Previously Amended) The circuit board according to claim 20, characterized in that a through hole (22) is provided in at least one of the individual layers (10), the through hole extending from the first functional side through the individual layer (10) and as far as to the second functional side thereof, and that the through hole (22) is filled with an electrically conductive material.

22. (Withdrawn) The circuit board according to claim 1, characterized in that at least one of the individual layers consists of an optically transparent material and that on this individual layer a waveguide trench (42) is provided which is filled with an optically transparent material the refractive index of which suitably differs from that of the material of the individual layer (10), so that a waveguide (40) is formed.

23. (Withdrawn) The circuit board according to claim 22, characterized in that the individual layer provided with the waveguide (40) comprises a mirror (44) by means of which light may be coupled into and out of the waveguide.

24. (Withdrawn) The circuit board according to claim 23, characterized in that the mirror (44) is a separate component which is inserted in the individual layer.

25. (Withdrawn) A method of manufacturing a circuit board (5), comprising the following steps:

at least two individual layer blanks (110) are produced by formation from a casting, each of the blanks being provided with positioning formation preforms (116) on first and second functional sides;

the individual layer blanks (110) are subjected to a pretreatment on their entire surface such that they can be provided with a metallization;

in those regions which are not intended to be provided with a metallization, the surface is subjected to a subsequent treatment, so that no metallization is deposited in these regions;

a metallization (18) is applied to the regions which have not been subjected to a subsequent treatment;

the individual layer blanks are placed on top of one another and at the same time precisely positioned in relation to each other by means of the positioning formations (16).

26. (Withdrawn) The method according to claim 25, characterized in that the pretreatment consists in applying a thin pre-metallization (118).

27. (Withdrawn) The method according to claim 26, characterized in that the subsequent treatment consists in mechanically removing the pre-metallization (118).

28. (Withdrawn) The method according to claim 25, characterized in that the pretreatment consists in dispersing seeds on the substrate.

29. (Withdrawn) The method according to claim 28, characterized in that the subsequent treatment consists in chemically removing the dispersed seeds.

30. (Withdrawn) The method according to claim 29, characterized in that the individual layers (10) are injection-molded.

REMARKS

A request for continuation examination (RCE) and RCE fee is submitted herewith together with a supplemental information disclosure statement and copies of listed references.

The present application includes claims 1-30 with claims 1-6, 11, 15 and 20-21 as drawn to the elected species of Figure 6. Claim 1 has been amended.

As to the § 103 rejection, applicants respectfully request reconsideration. It is noted that claim 1 as currently amended is directed to a circuit board consisting of at least two individual circuit board layers. Each circuit board has at least one microstructured positioning formation (16) which is comprised of at least one projection and at least one recess positioned in interconnecting engagement. The projection is formed on at least one of the first and second sides of one of the circuit board layers (10) and the recess is formed on at least one of the sides of another circuit board layer. The projection and the recess are positioned in interconnecting engagement with one another to allow for precise positioning of the circuit board layers relative to each other.

Claim 1 requires that each of the projection and the recess is formed integrally and simultaneously with the corresponding circuit board layer during formation of the circuit board layers and is formed of material which is the same as the circuit board layer, which material is plastic. Claim 1 further requires that at least one microstructured conductor trench (12) is formed on one of the functional sides of a circuit board layer. It is respectfully submitted that none of the references either alone or in combination with one another teach or suggest the claimed invention.

Applicants respectfully disagree that either reference to Crumly, U.S. Pat. Nos.

6,007,669 and 5,207,887 would render the claimed invention obvious. According to our understanding of the terms "formation technique", "integrally", "simultaneously" and "formed...during formation", the layers are formed by casting ("formation technique"), and the positioning formations are formed during the step of introducing the melted plastics material into the mold ("formed during formation") and consist of the same material as the circuit board layers ("formed integrally with the molded layers"). Provision of the positioning features by casting results in alignment of the circuit board layers with a precision which is superior to what can be achieved with positioning features provided by additional steps subsequent to formation of the board layer.

As expressed in the specification from page 9, line 21, to page 10, line 5, the molding tool is formed using a masterpiece produced by X-ray lithography and galvanic formation and copying techniques. The masterpiece shows all features which shall later be present on the board layers. These features, e.g. the positioning features, can be formed on the masterpiece with extremely high precision by X-ray lithography. This high precision will not be lost when the masterpiece is copied so as to form the mold for the board layers. As a result of the high precision, the board layers are suitable for being used for optical signal transmission (see in particular the embodiments of Figures 12 to 14) which require very precise alignment.

By contrast, the requirements for positioning circuit boards used solely for electrical signal transmission, as used in the cited references, are significantly lower. In electrical signal transmission, electrical contacts have a large surface area (necessary for soldering) which compensates for differences in tolerances. This can be seen by the large contact pads 14a shown in Rokugawa and the large contact pads 34 shown in Crumly '669.

Based on the above understanding of claim 1, the prior art does not show significant features of claim 1. Crumly '699 shows positioning formations which i) are formed from a material different from the material of the layer, and ii) are formed in a step which is in addition to the step of formation of the layer. It is impossible to form dielectric layer 10 in one and the same step with copper traces 12.

Crumly '887 again shows positioning formation which i) are formed from a material different from the material of the layer, and ii) are formed in a step in addition to formation of the layer (please see figures 6 to 9; raised feature pad 20 is provided first, and thereafter layer 26 is laminated to the pad).

The Examiner, at page 6 of the office action, argues that Crumly shows raised features (24) formed with formation of the circuit layers (18, 20). However, claim 1 defines that the raised features are formed integral and simultaneous with formation of the circuit board layers which are made of plastics. The Examiner appears to confuse the circuit layers of Crumly, which are made from copper and electrically conductive, with the board layers of the subject application, which is made from plastics and forms the support for the electrically conductive circuit layers.

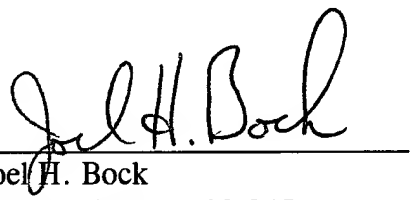
Both references to Crumly clearly teach and suggest positioning formations which are formed separately after formation of the circuit board layer. In Crumly '669, the raised features (14) are formed by subsequent steps of mechanical pressing, plating up a metal, or depositing a bump as desired. (Col. 2, lines 56-61). The underside or volume of the raised feature (14) is filled with some sort of material such as epoxy 25 or adhesive. (Col. 2, line 66 to col. 3, line 1). Crumly is precisely what applicants teach away from. In fact, on page 3 of

applicant's original specification, applicants discuss the disadvantages of separate finishing operations for the individual layers. The advantages of the claimed invention are that there is no need for a subsequent machining step in order to configure the geometric structures with high positional accuracy (page 3, lines 17-23). Amended claim 1 is respectfully believed to emphasize this feature.

As to Rokugawa U.S. 6,434,819, this reference is relied upon for no other reason than to show embedded conductors, and as such, it is not necessary to discuss this reference further.

It is respectfully submitted that claims 1-6, 11, 15 and 20-21 are distinguishable over the cited references. Reconsideration and allowance is respectfully requested.

Respectfully submitted,



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